



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

3.5.1.4 MISSILES GENERATED BY TORNADOES AND EXTREME WINDS

REVIEW RESPONSIBILITIES

Primary - Balance-of-Plant Branch (SBPB)

Secondary - Geosciences & Civil Engineering Branch (EGCB)

I. AREAS OF REVIEW

The SBPB staff reviews and evaluates the applicant's assessment of possible hazards attributable to missiles generated by high-speed winds, such as tornado, hurricane, and any other extreme winds identified in Section 3.5 of the safety analysis report (SAR), to ensure that the applicant has chosen and properly characterized appropriate design-basis missiles, and to ensure that the effects caused by those missiles are acceptable. Currently, only the missiles generated by design-basis tornadoes are consistently considered in the plant design bases. Missiles from hurricane and extreme winds are considered on a case-by-case basis when they are identified.

Review Interfaces

The SBPB staff performs the following review under the indicated SRP sections:

The SBPB also reviews the identification of those structures, systems, and components (SSCs) that should be protected against missile impact under Standard Review Plan (SRP) Section 3.5.2.

In addition, the SBPB coordinates with other branches' evaluations and reviews that interface with the overall review of this area as follows:

1. The EGCB determines the acceptability of the design analysis, procedures, and criteria used to establish the ability of seismic Category I structures and/or missile barriers to withstand the effects of tornado missiles as part of its primary review responsibility for SRP Section 3.5.3.
2. The Accident Dose Branch (AADB) determines the acceptability of the design-basis tornado parameters, including maximum wind speed, as part of its primary review responsibility for SRP Section 2.3.1.

DRAFT Rev. 3 - January 2006

USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public, as sections of NUREG-0800, as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the NRC's regulations, and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (Regulatory Guide 1.70). Not all sections of the standard format have a corresponding review plan.

Public comments are being solicited on this draft Standard Review Plan section. Comments should be accompanied by appropriate supporting data. Written comments may be submitted to the Rules and Directives Branch, Office of Administration, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Comments may be submitted electronically by email to NRCREP@nrc.gov or through the NRC's Draft NUREG-Series Publications for Comment Web page at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/docs4comment.html>. The comment period is 60 days from issuance of a notice of availability in the *Federal Register*. The notice of availability is expected within 1 week of publication of this standard review plan section. Comments submitted after the comment period will be considered as long as it is practicable to do so.

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For those areas of review identified above as being part of the review under other SRP sections, the acceptance criteria and their methods of application are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

The acceptability of the assessment as described in the applicant's safety analysis report (SAR) is based on compliance with General Design Criteria 2 and 4, as they relate to the capability of SSCs important to safety to withstand the effects of tornadoes and other natural phenomena. Acceptance is based on meeting the guidelines in Regulatory Guides 1.76 and 1.117.

The method of identifying appropriate design-basis missiles generated by natural phenomena shall be consistent with the acceptance criteria defined for the evaluation of potential accidents from external sources in SRP Section 2.2.3. Other methodologies used by licensees and applicants with appropriate rationale may be acceptable on a case-by-case basis.

Technical Rationale

The technical rationale for application of the above acceptance criteria to missiles generated by tornado and extreme winds is discussed in the following paragraphs:

1. GDC 2 establishes requirements regarding the ability of SSCs important to safety to withstand a tornado without the loss of capability to perform their safety functions. Application of GDC 2 ensures that the chosen design basis reflects the most severe tornadoes historically reported for the site and surrounding region. Regulatory Guide 1.76 describes a design-basis tornado that is acceptable to the NRC staff. A nuclear power plant must remain in a safe condition in the event of the most severe tornadoes that can reasonably be predicted. Designing a nuclear power plant to withstand the design-basis tornado and tornado missiles discussed in Regulatory Guide 1.76 ensures that there will be no undue risk to the health and safety of the public in the event of the most severe tornado conditions. Evolutionary reactors shall be designed based on regional wind speeds corresponding to strike probability of 10^{-7} per year, as defined in Regulatory Guide 1.76. Designing a nuclear power plant to withstand the design-basis maximum tornado wind speed ensures that SSCs important to safety will be capable of performing their safety function.
2. GDC 4 establishes requirements regarding the ability of SSCs important to safety to be protected from dynamic effects, including the effects of missiles, from events and conditions outside the nuclear unit. Tornadoes are dynamic events originating outside the nuclear unit; therefore, this criterion applies directly to the assessment of any missiles generated by tornadoes. To ensure the safety of nuclear power plants in the event of a tornado strike, it is required that, in addition to the direct action of tornado wind and the moving ambient pressure field, nuclear power plant designs must consider the impact of tornado-generated missiles. Protection from a spectrum of missiles exemplified by missiles with critical characteristics provides assurance that the necessary SSCs will be available to mitigate the potential effects of a tornado on plant safety. The selection of SSCs to be protected is based upon the methods in Regulatory Guide 1.117 and maintaining offsite exposures below an appropriate fraction of the offsite dose guidelines of 10 CFR Part 100. The design-basis tornado-generated missile spectrum in Regulatory Guide 1.76 is acceptable to the staff for the design of nuclear power plants.

III. REVIEW PROCEDURES

The procedures below are used during the construction permit (CP) review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary safety analysis report meet the acceptance criteria given in Subsection II. For review of operating license (OL) applications, the procedures are utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design, as set forth in the final safety analysis report. The review procedures are also applicable for standard design certification (SDC) and combined licence (COL) reviews under 10 CFR Part 52. In addition, the reviewer needs to ensure that the applicable site parameters have been included in Tier 1 information per guidance contained in SRP Section 14.3.1.

Upon request from the primary reviewer, EGCB will provide input for the areas of review stated in Subsection I. The primary reviewer obtains and uses such input as required to ensure that this review procedure is complete.

The reviewer will select and emphasize material from this SRP section, as may be appropriate for a particular case.

The judgment on areas to be given attention and emphasis in the review is to be based on an inspection of the material presented to see whether it is similar to that recently reviewed on other plants and whether items of special safety significance are involved.

1. The SAR is reviewed for the identification of the design-basis natural phenomena that could possibly generate missiles. Postulated missiles are reviewed for proper characterization.
2. Regulatory Guide 1.76 provides guidance on the definition and characterization of the design-basis tornado reviewed by the AADB as discussed in Subsection II.
3. The design-basis natural phenomena for the site are reviewed with respect to the potential for missile generation. For phenomena with greater potential for missile generation than the design-basis tornado (i.e., the probability per year of damage to the total of all SSCs important to safety is 10^{-7} per year or greater), appropriate design-basis missiles are proposed.
4. All plants are required to be designed to protect safety-related equipment against damage from missiles which might be generated by the design-basis tornado for that plant. The reviewer verifies that the applicant has postulated missiles that include at least (1) a massive high-kinetic-energy missile that deforms on impact, (2) a rigid missile to test penetration resistance, and (3) a small rigid missile of a size sufficient to just pass through any openings in protective barriers. Acceptable missiles and their associated wind speeds are identified in Table 2 of Regulatory Guide 1.76.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and the review and calculations support conclusions of the following type, to be included in the staff's safety evaluation report:

The basis for acceptance in the staff review is the conformance of the applicants' design criteria for the protection from the effects of natural phenomena to the Commission's regulations as set forth in the General Design Criteria, and to applicable regulatory guides and national standards.

The staff concludes that the assessment of possible hazards attributable to missiles generated by the design-basis tornado and other extreme winds is acceptable and conforms to the requirements of General Design Criterion 2 and General Design Criterion 4, as they relate to tornado-generated missiles. This conclusion is based on the applicant having met the requirements of General Design Criteria 2 and 4 by meeting (1) Regulatory Guide 1.76, Positions C-1 through C-3, and (2) Regulatory Guide 1.117, Positions C-1 through C-3.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

The staff will use this SRP section in performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein in its evaluation of conformance with the Commission's regulations.

The provisions of this SRP section apply to reviews of applications docketed 6 months or more after the date of issuance of this SRP section.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."
3. Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants."
4. Regulatory Guide 1.117, "Tornado Design Classification."

Paperwork Reduction Act Statement

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50, which the Office of Management and Budget (OMB) approved under OMB control number 3150-0011.

Public Protection Notification

The NRC may neither conduct, nor sponsor, and a person is not required to respond to, a request for information or an information collection requirement, unless the requesting document displays a currently valid OMB control number.

Description of Changes

1. Title
 - a. Changed title because other natural phenomena besides tornadoes and extreme winds do not generate credible missiles.
2. Review Responsibilities
 - a. Revised the name of the primary review branch to reflect the NRC's current organizational structure.
 - b. Added secondary review responsibilities.
3. Areas of Review
 - a. Deleted references to floods and other natural phenomena in order to conform with the revised title.
 - b. Revised the names of the review branches to reflect the NRC's current organizational structure.
 - c. Identified that SBPB is also responsible for reviewing the identification of SSCs that should be protected against missile impact under SRP Section 3.5.2.
 - d. Identified EGCB's responsible for determining the ability of seismic Category I structures and missile barriers to withstand the effects of tornado missiles as part of its primary review responsibility for SRP Section 3.5.3.
 - e. Identified AADB's responsibility for determining the acceptability of the design-basis tornado parameters as part of its primary review responsibility for SRP Section 2.3.1.
4. Acceptance Criteria
 - a. Added that other methodologies used by licensees and applicants with appropriate rationale may be acceptable on a case-by-case basis.
 - b. Added a subsection on "Technical Rationale."
5. Review Procedures
 - a. Revised the names of the review branches to reflect the NRC's current organizational structure.
 - b. Added that Regulatory Guide 1.76 provides guidance for the definition and characterization of the design-basis tornado that could potentially generate missiles.

- c. Clarified that appropriate design-basis missiles should be proposed for phenomena with greater potential for missile generation than the design-basis tornado (i.e., the probability per year of damage to the total of all SSCs important to safety is 10^{-7} per year or greater).
 - d. Eliminated the listing of Spectrum I missiles, and referenced Table 2 of Regulatory Guide 1.76.
 - e. Eliminated reference to Spectrum II, Spectrum A, and Spectrum B missiles.
 - f. Eliminated the April 1996 draft version reference to inspections, tests, analysis, and acceptance criteria (ITAAC) for SDC application reviews. The ITAAC associated with this specific issue would be associated with plant design/construction, which is reviewed in other SRP sections.
6. Evaluation Findings
- a. Deleted references to floods and other natural phenomena in order to conform with the revised title.
 - b. Eliminated the April 1996 draft version reference to inspections, tests, analysis, and acceptance criteria (ITAAC) for SDC application reviews. The ITAAC associated with this specific issue would be associated with plant design/construction, which is reviewed in other SRP sections.
7. Implementation
- a. Added that this SRP section applies to reviews under both 10 CFR Part 50 and 10 CFR Part 52.
8. References
- a. Eliminated the references to NBSIR 76-1050 and WASH-1300 because Regulatory Guide 1.76 has been updated (Revision 1) to provide the basis for the staff's design-basis tornado wind speeds and missile spectra.